Remarks

This amendment is responsive to the official action mailed May 15, 2007, and is accompanied by an extension under 37 C.F.R. §1.136(a) and the required official fee.

In the official action, claims 1, 5-6 and 10-13 were rejected as anticipated by the Parameswaran et al. publication entitled "A merged MEMS-CMOS process using silicon wafer bonding," IEDM 95, pp. 613-616. Claims 2-4 and 7-9 were rejected as obvious over Parameswaran in combination with US 4,463,336 – Black et al.

The claims have been amended to more particularly and distinctly define the subject matter of the invention and to better distinguish over the prior art of record. Reconsideration is requested in view of the amendment of the claims and the following discussion noting patentable distinctions of the invention claimed as a whole.

The claims have been generally amended to improve clarity, for example by including better antecedent basis and to better distinguish the method steps of independent method claims 1 and 5 and their dependent claims versus the structural aspects of apparatus claim 10 and its dependent claims. No new matter is presented. The number of claims remains within that for which filing fees were previously paid.

In the official action, former claims 1, 5-6 and 10-13 were considered anticipated under 35 U.S.C. 102(b) by the Parameswaran publication "A Merged MEMS-CMOS Process using Silicon Wafer Bonding." Parameswaran discloses certain aspects that are similar to applicant's invention, but does not disclose or suggest the invention defined in the amended claims as a whole.

Parameswaran discloses a method for forming microelectromechanical sensors (MEMS), wherein the sensors and the sensor signal processing electronics are monolithically integrated (page 23.6.1, col. 2, second paragraph, Figure 2). In Parameswaran, a first silicon wafer having cavities formed thereon is firmly connected to a second cap wafer having an epitaxial layer, by high temperature fusion bonding via the epitaxial layer (page 23.6.1, col. 2, last paragraph). Further, Parameswaran discloses that the wafer composite is reduced from the second wafer towards the

epitaxial layer and that the device wafer is thinned using grinding and polishing. As mentioned at page 23.6.1, col. 2, last paragraph, third sentence, the thickness of the epitaxial layer defines the thickness of the operable sensor part (the deformable or otherwise sensitive structure).

However, according to Parameswaran, after grinding and polishing the layer, electrochemical etching is carried out, which stops at the n-epitaxial layer, to produce the uniform 10 μm-thick membranes over enclosed cavities. This teaching does not meet applicant's claimed invention in that Parameswaran does not disclose or suggest that an electronic sensor structure is commonly formed on the polished surface. See applicant's claim 1 as amended, lines 15-19; claim 5 lines 12-15; claim 10, lines 11-14, etc. Parameswaran does not meet the invention claimed as a whole.

According to the present invention, wet etching is not required up to the electrochemical etch stop of the n-type epitaxial layer of the device wafer. As can be seen from Fig. 2 of Parameswaran, the prior art device wafer consists of a p-bulk wafer and an n-epi layer. Such a wafer structure causes a p-n transition in the vertical direction (as illustrated). The p-n transition necessitates electrochemical etching which stops at the n-epitaxial layer. This is important to Parameswaran and used to form the membrane over the cavities.

Applicant's claimed invention differs from Parameswaran, and there is no basis to conclude that the invention as a whole would have been known or obvious. According to applicant's invention, doping of the bulk-material and the epi-layer of the device-wafer (the membrane-wafer) is not a condition similarly affecting the structural configuration of the apparatus or the steps taken to produce the apparatus. In the case of applicant's method and apparatus, the epi-layer is not a necessary condition to provide an electrochemical etch stop, i.e., a p-n transition at that point.

The epi-layer of applicant's claimed invention allows the invention to exploit standard CMOS technology to contribute to the structure and function of a MEMS device and include an analog or digital circuit. The epi-layer is used to establish a thin oxide, but not, for example, as a gate-oxide or tunnel-oxide. Parameswaran's disclosure does not meet the subject matter defined in claim 1. Applicant requests

reconsideration and withdrawal of the rejection of independent claim 1 and dependent claims 2-4 under 35 U.S.C. §102(b) and allowance of those claims together with new claim 14.

Similar comments apply to the method as defined in claims 5-9 and 15 and 10-13. There is no basis to conclude that applicant's methods for forming a microelectromechanical sensor or system (MEMS), defined as a whole in claim 5, would have been known or obvious from Parameswaran. Claim 5 defines the additional aspect that after the polishing process at the sensor structure aligned to the cavity, at least one of an analog and digital circuit is formed on the polished surface, at least partly in the thinned epitaxial layer, using CMOS technology. This feature is not found in Parameswaran and there is no basis to consider it obvious. Therefore, claim 5 its dependent claims 6-9 and 15 are novel and properly allowable over Parameswaran.

Likewise, Parameswaran does not disclose or suggest the micromechanical sensor or system (MEMS), as defined in apparatus claim 10. It is possible that elements (i) and (ii) may be known from the cited reference, but there is no disclosure in Parameswaran to the effect that the mechanical sensor structure is aligned to the cavity and is commonly provided with an analog and/or digital circuit on the polished surface, and at least partially in the thinned epitaxial layer. Claim 10 recites a mechanical sensor structure aligned to the cavity and commonly provided with one of an analog and digital circuit on the polished surface at least partially in the thinned epitaxial layer, formed at the polished surface by monolithic integration. There is no articulated basis of record to conclude that the invention claimed as a whole would have been known or obvious. Reconsideration and allowance of claim 10 are requested.

As to claims 2-4 and 7-9, the official action suggests under 35 U.S.C. §103 that the invention would routinely result from a combination of features selected from Parameswaran and US 4,463,336 – Black. However, neither Black nor Parameswaran nor any routine combination meets the subject matter of applicant's invention claimed as a whole. Black does not disclose or suggest the aspects that are missing from the micromechanical sensor of Parameswaran, and vice-versa.

As described in column 5, lines 25 to 55 of Black, a field assisted bonding is employed by which a borosilicate glass layer (38) is used to adhere and tightly seal a first wafer (20) and a second wafer (40) to one another. This technique, as well as the resulting apparatus, does not meet the micromechanical sensor or system methods and apparatus defined in applicant's claims as a whole.

The claims have been amended to better define the invention, including better reliance in the method claims on method aspects and in the apparatus claims on structures and new claims. There is no explanation of record to explain how one can conclude that all the aspects of claims 1, 5 and 10 as a whole would be reached routinely and with predictable success from Parameswaran and Black, by the person of ordinary skill in the art working in this technical field. The combination of these documents does not lead to the invention claimed as a whole.

The claims as amended are definite. The differences between the invention claimed as a whole and the prior art of record are such that the subject matter claimed, as a whole, is not shown to have been known, or obvious.

Applicant therefore requests allowance of claims 1-15.

Respectfully submitted,

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